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Langebrogade 1
PO Box 17
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Denmark

05660873002

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

Denmark

4. Title of the invention

COMPOSITION

5. Name of your agent (if you have one)

D Young & Co

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

21 New Fetter Lane
London
EC4A 1DA

Patents ADP number (if you know it)

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Number of earlier application

Date of filing
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Description 37

Claim(s) 4

Abstract 1

Drawing(s) 9 + 7 *13*

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Statement of inventorship and right to grant of a patent (Patents Form 7/77) 0

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11. I/We request the grant of a patent on the basis of this application.

Chas Harding

Signature

Date 05 August 2002

D Young & Co (Agents for the Applicants)

12. Name and daytime telephone number of person to contact in the United Kingdom.. Charles Harding 023 8071 9500

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COMPOSITION

Field of invention

- 5 The present invention relates to a composition.

Introduction

Several useful microbial polysaccharides are currently commercially produced via
 10 fermentation processes. These polysaccharides have already found specific applications
 in diverse fields such as food/feed industry, agro-chemistry, crude-oil recovery, medicine
 and pharmacology, fine chemistry and cosmetics, separation technology and polymer
 chemistry. Useful microbial polymers are biodegradable, non-toxic and are formed via
 fermentation from renewable resources. Many microorganisms (bacteria, fungi, yeasts,
 15 micro-algae) produce such polymers, intra-cellularly, extra-cellularly (exo-
 polysaccharides) or as part of their outer cell wall.

Many lactic acid bacteria (LAB) are able to produce exo-polysaccharides (EPS) (Cerning,
 1990, *FEMS Microbiol. Rev.* 87: 113-472). As used herein, the term EPS includes one
 20 type of exo-polysaccharide or two or more exo-polysaccharides.

Sometimes, EPS-producing LAB are responsible for undesirable ropiness in food
 products such as wine (Llauberes *et al.*, 1990, *Carbohydr. Res.* 203: 103-107), and cider
 (Whiting, 1975, *Lactic Acid Bacteria in Beverages and Food*, Academic Press, London
 25 pp. 69-86). However, in many cases, the polysaccharides released exo-cellularly by
 LAB may offer advantages in a variety of fermented food products. Indeed, lactic acid
 bacteria play a pivotal role in the manufacturing of fermented dairy products such as
 yoghurt, drinking yoghurt, cheese, fermented cream, milk based desserts and others.

- There is a large diversity of EPS produced by different LAB in terms of quality, chemical composition, molecular size, charge, presence of side chains and rigidity of the molecules. EPS can act both as texture improvers and stabilisers, firstly by increasing the viscosity and elasticity of the final product, and secondly by binding hydration water and interacting with other milk constituents, such as proteins and micelles, to strengthen the rigidity of the casein network. As a consequence, EPS can decrease syneresis (serum separation) and improve product stability.
- 10 The microflora of the large intestine comprises several hundred different bacterial species. This complex community and their metabolic activities have a fundamental effect on the host. Despite the lack of complete understanding of the ecological interactions between the bacteria themselves and the host, experimental data indicate that certain bacteria are believed to benefit the host whereas others may be harmful due to
- 15 production of toxins and genotoxic metabolites or as a result of mucosal invasion. One approach to positively affect the composition of the intestinal microflora and their metabolic activity is the ingestion of so-called prebiotics. These are defined as 'non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a number of beneficial bacteria in the gut and thus
- 20 improve health (Gibson and Roberfroid, 1995, *J. Nutr.* 125: 1401-1412). Potentially health-promoting bacteria are thought to be species of the genera *Lactobacillus* and *Bifidobacterium* (Orrhage and Nord, 2000, *Drugs Exp. Clin. Res.* 26: 95-111).

-
- It has been reported that EPS may affect gut health. It is speculated that the increased
- 25 viscosity of EPS containing foods may increase the residence time of ingested fermented milk in the gastrointestinal tract and therefore be beneficial to a transient colonisation by probiotic bacteria (German *et al.*, 1999, *Trends in Biotechnology*, 17,492-499). EPS produced by *Lactobacillus lactis* subsp *cremoris* B40 and *Lactobacillus sakei* 0-1, *S. thermophilus* SFi 20 was shown to be resistant to degradation by faecal microorganisms
- 30 (Ruijsenaars *et al.*, 2000, *Current Microbiology*, 40, 194-199).

EPS have been suggested to have anti-tumour, cholesterol lowering and immune-modulatory effect (Ode *et al.*, 1983, *Agricultural and Biological Chemistry*, 47:1623-1625; Honoso *et al.*, 1997, *Bioscience. Biotechnology and Biochemistry*, 61: 312-316; Vincent *et al.*, 2001, *Glycobiology*, 11: 131-139).

5

EPS have been suggested as food ingredients. By way of example, reference can be made to WO 94/12656 wherein a process for producing EPS from a *Lactobacillus sake* like strain is described wherein said EPS has shear-thinning properties and/or thickening and/or emulsion-stabilising properties when added to food products. This process
10 comprises inoculating a medium with an EPS producing strain of bacteria; growing said bacterium under suitable conditions whereby said EPS is formed and isolating said EPS which can then be added as an ingredient to food products wherein said EPS provides shear-thinning, thickening and/or emulsion-stabilising properties to foods containing said EPS.

15

US 6,004,800 describes a novel *Leuconostoc mesenteroides* ssp. *cremoris* capable of producing dextran sucrose which is capable of converting sucrose into the polysaccharide dextran which in turn is used in texturing and improving the taste of dairy products.

20 WO 01/57234 describes a natural isolate of *Lactobacillus lactis* ssp. *cremoris* Ropy 352 which contains a plasmid that encodes 13 active genes. The enzymes encoded by these genes permit the bacteria to produce an exopolysaccharide (EPS 352) which is charged, contains 54% to 58% glucose, 42% to 46% galactose and has a molecular weight in the range of 800,000 to 8,000,000. The addition of EPS 352 to milk or other liquids, imparts
25 desirable sensory characteristics to the milk, including making the milk very thick, with a fine and smooth mouth-feel, and a slight sweetness with a "chewable-bite". It is also mentioned that Ropy 352 producing EPS, or EPS 352 alone may be added to any milk-based or non-milk based product, including any liquid food product, to produce the specified sensory characteristics.

30

Rawson & Marshall, 1997 report that the ropy strains *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Lb. bulgaricus* can improve the 'adhesiveness' of stirred yoghurt products. Although 'adhesiveness' was shown to be due to the effects of the secreted EPS, 'firmness' and 'elasticity' of the stirred yoghurt products were influenced by protein-protein interactions and the protein matrix of the yoghurt (Rawson & Marshall, 1997, *Int. Journal of Food Science and Technology*, 32, 213-220).

Broadbent *et al.*, report that encapsidated, but not ropy, EPS producing *Streptococcus thermophilus* lactic acid bacteria can be used to increase moisture content and improve melt in Mozzarella cheese, without deleteriously affecting whey viscosity (Broadbent *et al.*, 2001, *Int. Dairy J.*, 11, 433-439).

Hess *et al.*, report that yoghurt made with exopolysaccharide producing strains of *Lactobacillus delbrueckii* ssp. *bulgaricus* exhibit less shear thinning than products made with non-EPS producing strains which is consistent with a mechanism for shear-induced structural degradation of yoghurt made using EPS producing strains in which polymer associated with the casein network prevents disruption of portions of the network (Hess *et al.*, 1997, *J. Dairy Sci.*, 80, 252-263).

EP 0325872 describes a process for preparing oligodextrins characterised in that sucrose and a sugar acceptor of glucose chosen from a group consisting of maltose, isomaltose, isomaltotriose, methyl -glucoside and glucose are brought into contact in the presence of glucosyltransferase enzyme extracted from the strain NRRL B-1299 of the lactic acid bacterium *Leuconostoc mesenteroides*. These oligodextrins are then separated from the live culture of *Leuconostoc mesenteroides* and used as fillers in sugar substitutes or as food staff additives having a beneficial effect on the intestinal flora of humans or animals.

WO 01/90319 discloses a novel protein having fructosyl transferase which is capable of catalysing the formation of oligosaccharides or polysaccharides, produced by *Lactobacillus reuteri*. A process for producing said enzyme comprising culturing said

lactobacilli in a culture medium and recovering said enzyme from culture medium or the cell free extract and using said *lactobacilli* containing said enzyme capable of producing oligosaccharides or polysaccharides as a probiotic or a symbiotic.

- 5 Similarly, WO 01/90372 discloses a novel protein having glucosyl transferase activity produced by *Lactobacillus reuteri*. A process for producing said enzyme comprising culturing said *lactobacilli* in a culture medium and recovering said enzyme from culture medium or the cell free extract and using said *lactobacilli* containing said enzyme as a probiotic or a symbiotic.

10

EP 0881283 discloses a new strain of *Leuconostoc mesenteroides* ssp. *cremoris* capable of producing an enzyme (dextran-sucrase) which can polymerise saccharose and form dextran. This application also discloses a process for producing a composition comprising said enzyme and said dextran for use in the food and cosmetics industry.

15

Broad Aspects

- In a broad aspect, the present invention relates to a composition for consumption. The composition may be for use as a product for consumption or as an ingredient of a product
- 20 for consumption. In particular, the present invention relates to a composition comprising a viable lactic acid bacterium (LAB), an enzyme synthesised by said lactic acid bacterium and an EPS produced by said enzyme. Thus the present invention relates to a composition and a method of preparing or treating products for consumption so as to improve their aroma, flavour, mildness, consistency, texture, body, mouth feel, firmness,
- 25 viscosity, gel fracture, wheying off, structure and/or organoleptic properties, nutrition and/or health benefits. In particular, the present invention provides a composition comprising a live micro-organism, an enzyme produced by said micro-organism and an EPS produced by the activity of said enzyme.
- 30 To date, no one has suggested the use of said composition as a food product or as an ingredient, such as an ingredient for a range of different food products.

Other aspects of the present invention are presented in the accompanying claims and in the following description. These aspects are presented under separate section headings. However, it is to be understood that the teachings under each section are not necessarily
5 limited to the particular section heading.

Specific Aspects

In one aspect, the present invention provides a composition for consumption where the
10 composition comprises a viable lactic acid micro-organism, an enzyme synthesised by said micro-organism and an EPS product of said enzyme.

In another aspect the EPS product is formed *in situ* by cultivating the lactic acid micro-organism with a suitable enzyme substrate. A suitable enzyme substrate can be any sugar
15 molecule such as a mono-saccharide, di-, tri- or terta-saccharide.

In yet another aspect there is provided a composition wherein the enzyme is either a glycosyl transferase enzyme capable of polymerising sucrose or a fructosyl transferase enzyme capable of polymerising sucrose.
20

The present invention further provides a method for preparing a product for consumption – such as a food product or a food ingredient - the method comprising admixing the composition of the present invention with another component so as to form said product
for consumption.

25

The present invention also provides a method for preparing a pharmaceutical product or a pharmaceutical ingredient – the method comprising admixing the composition of the present invention with another component.

In another aspect the present invention relates to the use of a composition comprising a lactic acid micro-organism, an enzyme derived from said lactic acid micro-organism capable of producing an EPS and an EPS produced by said enzyme, wherein said EPS
5 has been produced by said viable micro-organism, for improving the aroma, flavour, mildness, consistency, texture, body, mouth feel, firmness, viscosity, gel fracture, wheying off, structure and/or organoleptic properties, nutrition and/or health benefits of said food product according to the present invention.

10 In yet another aspect the present invention relates to the use of a composition according to the invention wherein said lactic acid bacteria and EPS act as prebiotics when used as ingredients to products for consumption or to pharmaceutical products.

The present invention also relates to a process for *in situ* producing a composition
15 comprising growing said lactic acid bacteria in a medium (preferably an edible medium) under conditions where enzyme is produced and EPS is formed until the number of said lactobacilli is in a suitable amount – typically in the order of about 10^3 to about 10^{11} , preferably about 10^5 to about 10^{11} per ml and more preferably about 10^8 to about 10^{11} per ml.

20 In a further aspect the present invention provides a method for screening for a suitable composition for use in the present invention, said method comprising contacting a candidate composition with a food product and determining the extent of improvement in texture, body, mouth feel, viscosity, structure and/or organoleptic properties of to said
25 food product; wherein said composition comprises a viable micro-organism, and enzyme produced by said micro-organism and an EPS produced by said enzyme.

A further aspect of the present invention relates to use a composition comprising a viable lactic acid micro-organism, enzyme synthesised by said micro-organism and an EPS
30 made up of homopolysaccharide and heteropolysacchride molecules produced by said enzyme.

Preferable Aspects

5 In a preferred aspect, the composition for use in the present invention is used in a concentrated form.

Preferably, the composition for use in the present invention is spray-dried, frozen, freeze dried and/or re-suspended.

10 Preferably, the viable micro-organism for use in the present invention is a lactic acid micro-organism which can be selected from a group comprising *Lactococcus*, *Streptococcus*, *Pediococcus*, *Enterococcus*, *Leuconostoc*, *Carnobacterium*, *Propionibacterium*, *Bifidobacterium* and *Lactobacillus* genuses.

15 In a preferred aspect the viable micro-organism for use in the present invention is from the genus *Leuconostoc*.

In a preferred aspect the viable micro-organism for use in the present invention is *Leuconostoc mesenteroides*.

20

In a preferred aspect the viable *Leuconostoc mesenteroides* is capable of producing an enzyme wherein said enzyme is either glycosyl transferase or fructosyl transferase.

25 In a preferred aspect the *Leuconostoc mesenteroides* produced enzymes is capable of catalysing sucrose into an EPS.

In a preferred aspect the EPS produced by said *Leuconostoc mesenteroides* produced enzyme comprises at least a long chain polymer (polysaccharide) and/or a short chain polymer (oligosaccharide).

30

In a preferred aspect the polysaccharide or the oligosaccharide components of the EPS comprise fructan and/or glucan.

5 Preferably, the present invention provides a composition that can be used to ferment milk or any other equivalent and produce a yoghurt like ingredient containing structure forming EPS and/or nutritional oligosaccharides.

10 Preferably, the present invention provides a composition which can be used as an ingredient to food wherein the live lactobacilli, the EPS and/or the oligosaccharide components of the composition exhibit a beneficial effect on the gastrointestinal microflora of consumers.

15 In another preferred aspect, the present invention provides a composition which can be used as a food ingredient wherein the EPS and/or the oligosaccharides component of the composition have immunomodulatory effect on the gastrointestinal immune system of consumers.

20 Preferably the compositions for use in the present invention are in the form of concentrates which comprise a substantially high concentration of a viable micro-organism, and/or an enzyme produced by said microorganism and/or and EPS produced by said enzyme.

Advantages

25 Some advantages of the present invention are presented in the following commentary.

A primary advantage of the composition of the present invention is its capacity to improve the aroma, flavour, mildness, consistency, texture, body, mouth feel, firmness, viscosity, gel fracture, wheying off, structure and/or organoleptic properties and nutrition
30 of products for consumption containing said composition.

For some applications, the composition of the present invention can lead to a significant decrease in syneresis (serum separation) and improve product stability.

5 The composition of the present invention can also be used in combination with other components of products for consumption to deliver said improvements.

The present invention also covers using the composition of the present invention as a component of pharmaceutical combinations with other components to deliver medical or physiological benefit to the consumer.

10

Micro-organism

Suitable viable micro-organisms for use in the present invention include bacteria, moulds and/or yeasts.

15

The term "viable micro-organism" means a micro-organism which is capable of normal growth and development. Also it is to be understood that where reference is made in the present specification, including the accompanying claims, to 'a' viable micro-organism or 'an' anti-microbial agent, such reference is meant to include one or more viable micro-organisms or one or more anti-microbial agents, and mixtures thereof, unless it is specifically stated otherwise in the text.

20

The micro-organism may be a naturally occurring micro-organism or it may be a transformed micro-organism. The micro-organism may also be a combination of suitable micro-organisms.

25

In a preferred aspect, the viable micro-organism of the present invention may be selected from a group comprising various strains of lactic acid bacteria such as *Lactococcus*, *Streptococcus*, *Pediococcus*, *Enterococcus*, *Leuconostoc*, *Carnobacterium*, *Propionibacterium*, *Bifidobacterium* and *Lactobacillus* genuses.

30

In a preferred aspect the viable micro-organism is *Leukonostoc mesenteroides* spp.

Advantageously, where the product is a foodstuff, the viable micro-organism and/or enzyme produced by said micro-organism and/or EPS produced by said enzyme should remain effective through the normal "sell-by" or "expiration" date during which the food product is offered for sale by the retailer. Preferably, the effective time should extend past such dates until the end of the normal freshness period when food spoilage becomes apparent. The desired lengths of time and normal shelf life will vary from foodstuff to foodstuff and those of ordinary skill in the art will recognise that shelf-life times will vary upon the type of foodstuff, the size of the foodstuff, storage temperatures, processing conditions, packaging material and packaging equipment.

EPS

The EPS may be any suitable EPS that is obtainable from a lactic acid bacteria.

The EPS component of the composition may comprise homopolysaccharide molecules and/or heteropolysaccharide molecules.

As used herein the term "homopolysaccharide" means a polysaccharide molecule which is constructed from one sugar molecule such as any one mono-saccharide, di-, tri-, or tetra-saccharide units.

As used herein the term "heteropolysaccharide" means a polysaccharide molecule which is constructed from two or more of mono-saccharide, di-, tri-, or tetra-saccharide units.

Medium

The present invention also provides a medium comprising a viable lactic acid micro-organism, which produces effective and/or increased amounts of an enzyme capable of catalysing an EPS for improving the aroma, flavour, mildness, consistency, texture, body,

mouth feel, firmness, viscosity, gel fracture, wheying off, structure and/or organoleptic properties, nutrition and/or health benefits to product for consumption.

5 In addition, the present invention provides a medium comprising viable *Leuconostoc mesenteroides* which produces effective and/or increased amounts of a glycosyl transferase or fructosyl transferase capable of polymerising sucrose and converting it into an EPS which comprises at least a long chain polysaccharide or a short chain oligosaccharide which may be used as a food component with optimised nutritional and health benefit.

10 Also the present invention provides a medium comprising viable *Leuconostoc mesenteroides* which produces effective and/or increased amounts of a glycosyl transferase or fructosyl transferase capable of polymerising maltose and converting it into an EPS which comprises at least a long chain polysaccharide or a short chain
15 oligosaccharide which may be used as a food component with optimised nutritional and health benefit.

While preparing the composition of the present invention, it is also possible to adjust the ratio of sucrose and maltose of the medium during the fermentation such that a targeted
20 molecular weight distribution of polysaccharide or oligosaccharide can be obtained. The ability to control the molecular weight of the polysaccharide or oligosaccharide can be used for regulating the viscosity of the products comprising the composition of the present invention.

25 As used herein, the term "polysaccharide" refers to a carbohydrate molecule which is composed of more than 10 sugar units where one sugar unit can be a mono-saccharide, di-, tri-, or tetra-saccharides.

Also used herein the term "oligosaccharide" refers to a carbohydrate molecule which
30 comprises less than 10 sugar molecules where the sugar molecules can be any one or more of mono-saccharides, di-, tri-, and tetra-saccharides.

Preferably, the polysaccharide and/or the moligosaccharide are composed of mono-saccharides and/or di-saccharides. By way of example, mono-saccharides include but are not limited to sugars such as glucose and fructose and di-saccharides include but are not limited to sugars such as sucrose, lactose and maltose.

Thus, in one aspect, the medium may optionally be supplemented with any one of a mono-saccharide, di-, tri-, or tetra-saccharide. Here, the composition that is produced by the viable lactic acid micro-organism has one or more EPS wherein at least some (preferably a large proportion) of the EPS is/are homopolysaccharide molecules.

In another aspect, the medium which may be used in the process of the present invention may optionally be supplemented with two or more of mono-saccharide, di-, tri-, or tetra-saccharides. Here, the composition that is produced by the viable lactic acid micro-organism has one or more EPS wherein at least some (preferably a large proportion) of the EPS is/are heteropolysaccharide molecules.

In a preferred aspect, the medium is an edible medium. The term "edible medium" means any growth medium which can support lactobacilli growth and which is commercially acceptable for consumption such as for instance milk from animal, plant or synthetic origin or lactic medium as described in the Examples.

Preparation of the Composition

The composition may be prepared by an *in situ* process — of the type mentioned herein. In this case, suitable micro-organisms are present in an edible medium that can support the growth of the micro-organisms such that they yield the EPS.

Optionally, the components of the composition can be prepared in isolation and then the components may be combined together to form the composition. By way of example EPS can be produced *in situ* by growing lactic acid bacteria in a commercially acceptable

medium under conditions where EPS is formed. The resulting EPS can be isolated from the fermentation media by any suitable technique e.g. by means of a precipitation using an organic solvent in which the EPS is not soluble or has limited solubility. Another way of isolating the EPS is by removal of the water, e.g. by evaporation, membrane filtration or spray drying. By producing the EPS in a commercially acceptable medium, a product for consumption containing said EPS will not require labelling as containing an additive. By commercially acceptable medium it is meant any medium capable of being used as a medium to produce the composition of the present invention.

10 Alternatively, the composition of the present invention can be synthesised for example by recombinant micro-organisms, which do not necessarily have to be lactic acid micro-organisms.

The term "recombinant micro-organism" means a micro-organism which carries a recombinant nucleotide sequence coding for an enzyme which is capable of producing EPS such that both the enzyme and the EPS can be used as components of the composition of the present invention.

Furthermore, the lactic acid micro-organism component of the composition of the present invention may also be grown separately in a commercially acceptable medium to a cell density such that it does not form EPS or enzyme which produces said EPS. It is important that the viability of the resulting culture is maintained which can be achieved by different methods known in the art for example by spray drying or freeze drying.

25 The process of the present invention can be used for *in situ* production of the composition comprising growing said lactic acid bacteria in a commercially acceptable medium such as dairy liquid medium optionally supplemented with extra carbon source which is also a suitable enzyme substrate such as the disaccharides sucrose and/or maltose under conditions where enzyme is produced and EPS is formed. The ratios of the disaccharides can be varied or adjusted during fermentation so that a targeted molecular weight distribution of polymer can be achieved. Therefore, by altering the sucrose and/or

maltose ratios it is possible to artificially regulate the polymerisation process and thus modulate viscosity. Preferably the product obtained by said process is not thereafter subjected to an intensive shear treatment. Such culture containing said composition or optionally each isolated component can advantageously be added into dairy ingredient-containing products such as dressings, margarine, mayonnaise, and spreads, and low-fat or zero-fat substitutes thereof, yoghurt based drinks and others.

Thus, it is also within the scope of the present invention that by altering the ratios of maltose and sucrose it is possible to modulate the degree of EPS polymerisation using maltose as an acceptor molecule.

Combination with other components

The composition of the present invention may be used in combination with other components. Thus, the present invention also relates to combinations.

The combination of the present invention comprises the composition of the present invention and another component which is suitable for animal or human consumption and is capable of providing a medical or physiological benefit to the consumer.

Other components of the combinations of the present invention include polydextrose, such as Litesse®, and/or a maltodextrin. These other components may be optionally added to the composition to assist the drying process and help the survival of the micro-organisms.

Further examples of other suitable components include one or more of: thickeners, gelling agents, emulsifiers, binders, crystal modifiers, sweeteners (including artificial sweeteners), rheology modifiers, stabilisers, anti-oxidants, dyes, enzymes, carriers, vehicles, excipients, diluents, lubricating agents, flavouring agents, colouring matter, suspending agents, disintegrants, granulation binders etc. These other components may

be natural. These other components may be prepared by use of chemical and/or enzymatic techniques.

As used herein the term "thickener or gelling agent" as used herein refers to a product that prevents separation by slowing or preventing the movement of particles, either droplets of immiscible liquids, air or insoluble solids. Thickening occurs when individual hydrated molecules cause an increase in viscosity, slowing the separation. Gelation occurs when the hydrated molecules link to form a three-dimensional network that traps the particles, thereby immobilizing them.

The term "stabiliser" as used here is defined as an ingredient or combination of ingredients that keeps a product (e.g. a food product) from changing over time.

The term "emulsifier" as used herein refers an ingredient (e.g. a food product ingredient) that prevents the separation of emulsions. Emulsions are two immiscible substances, one present in droplet form, contained within the other. Emulsions can consist of oil-in-water, where the droplet or dispersed phase is oil and the continuous phase is water; or water-in-oil, where the water becomes the dispersed phase and the continuous phase is oil. Foams, which are gas-in-liquid, and suspensions, which are solid-in-liquid, can also be stabilised through the use of emulsifiers. Aeration can occur in a three phase system where air is entrapped by liquid oil then stabilised by agglomerated fat crystals stabilised with an emulsifier. Emulsifiers have a polar group with an affinity for water (hydrophilic) and a non-polar group which is attracted to oil (lipophilic). They are

absorbed at the interfaces of the two substances, providing an interfacial film acting to stabilise the emulsion. The hydrophilic/lipophilic properties of emulsifiers are affected by the structure of the molecule. These properties are identified by the hydrophilic/lipophilic balance (HLB) value. Low HLB values indicate greater lipophilic tendencies which are used to stabilise water-in-oil emulsions. High HLB values are assigned to hydrophilic emulsifiers, typically used in oil-in-water emulsions. These values are derived from simple systems. Because foods often contain other ingredients

that affect the emulsification properties, the HLB values may not always be a reliable guide for emulsifier selection.

5 As used herein the term "binder" refers to an ingredient (e.g. a food ingredient) that binds the product together through a physical or chemical reaction. During "elation" for instance, water is absorbed, providing a binding effect. However, binders can absorb other liquids, such as oils, holding them within the product. In the context of the present invention binders would typically be used in solid or low-moisture products for instance baking products: pastries, doughnuts, bread and others.

10

The term "crystal modifier" as used herein refers to an ingredient (e.g. a food ingredient) that affects the crystallisation of either fat or water. Stabilisation of ice crystals is important for two reasons. The first is directly related to the product stability from a separation standpoint. The more freeze/thaw cycles a product encounters, the larger the ice crystals become. These large crystals can break down product structure, either naturally occurring, as in the case of cell walls, or that which is created by "elation". Because the water is no longer held in place, the product may exhibit syneresis, or weeping, after thawing. Secondly, in the case of a product which is consumed frozen, these large crystals result in an undesirable, gritty mouth feel.

20

"Carriers" or "vehicles" mean materials suitable for compound administration and include any such material known in the art such as, for example, any liquid, gel, solvent, liquid diluent, solubilizer, or the like, which is non-toxic and which does not interact with any components of the composition in a deleterious manner.

25

Examples of nutritionally acceptable carriers include, for example, water, salt solutions, alcohol, silicone, waxes, petroleum jelly, vegetable oils, polyethylene glycols, propylene glycol, liposomes, sugars, gelatin, lactose, amylose, magnesium stearate, talc, surfactants, silicic acid, viscous paraffin, perfume oil, fatty acid monoglycerides and diglycerides, 30 petroethral fatty acid esters, hydroxymethyl-cellulose, polyvinylpyrrolidone, and the like.

Examples of excipients include one or more of: microcrystalline cellulose and other celluloses, lactose, sodium citrate, calcium carbonate, dibasic calcium phosphate, glycine, starch, milk sugar and high molecular weight polyethylene glycols.

- 5 Examples of disintegrants include one or more of: starch (preferably corn, potato or tapioca starch), sodium starch glycollate, croscarmellose sodium and certain complex silicates.

- Examples of granulation binders include one or more of: polyvinylpyrrolidone,
10 hydroxypropylmethylcellulose (HPMC), hydroxypropylcellulose (HPC), sucrose, maltose, gelatin and acacia.

Examples of lubricating agents include one or more of: magnesium stearate, stearic acid, glyceryl behenate and talc.

15

Examples of diluents include one or more of: water, ethanol, propylene glycol and glycerin, and combinations thereof.

- The other components may be used simultaneously (e.g when they are in admixture
20 together or even when they are delivered by different routes) or sequentially (e.g they may be delivered by different routes).

Preferably, when the composition of the present invention when admixed with any other components, the lactic acid micro-organisms remain viable.

25

- As used herein the term "component suitable for animal or human consumption" means a compound which is or can be added to the composition of the present invention as a supplement which may be of nutritional benefit, a fibre substitute or have a generally beneficial effect to the consumer. The ingredients can be used in a wide variety of
30 products that require gelling, texturising, stabilising, suspending, film-forming and

structuring, retention of juiciness, without adding unnecessary viscosity. Preferably, the ingredients will be able to improve the shelf life and stability of the viable culture.

5 The components may be prebiotics such as alginate, xanthan, pectin, locust bean gum (LBG), inulin, guar gum, galacto-oligosaccharide (GOS), fructo-oligosaccharide (FOS), lactosucrose, soybean oligosaccharides, palatinose, isomalto-oligosaccharides, gluco-oligosaccharides and xylo-oligosaccharides.

10 The optimum amount of the composition to be used in the combination of the present invention will depend on the product to be treated and/or the method of contacting the product with the composition and/or the intended use for the same. The amount of viable micro-organism and/or enzyme produced by said micro-organism and/or EPS produced by said enzyme used in the compositions should be a sufficient amount to be effective and to remain sufficiently effective in improving the aroma, flavour, mildness,
15 consistency, texture, body, mouth feel, viscosity, structure and/or organoleptic properties, nutrition and/or health benefits of food products containing said composition. This length of time for effectiveness should extend up to at least the time of utilisation of the product.

20 Concentrates

The compositions for use in the present invention may be in the form of concentrates. Typically these concentrates comprise a substantially high concentration of a viable micro-organism, and/or an enzyme produced by said microorganism and/or and EPS
25 produced by said enzyme.

Powders, granules and liquid compositions in the form of concentrates may be diluted with water or resuspended in water or other suitable diluents, for example, an appropriate growth medium such as milk or mineral or vegetable oils, to give compositions ready for
30 use.

The combinations of the present invention in the form of concentrates may be prepared according to methods known in the art.

5 In one aspect of the present invention the product is contacted by a composition in a concentrated form. Preferably, the product is contacted by a spray-dried and/or resuspended composition.

The compositions of the present invention may be spray-dried or freeze-dried by methods known in the art.

10

Typical processes for making particles using a spray drying process involve a solid material which is dissolved in an appropriate solvent (e.g. a culture of a micro-organism in a fermentation medium). Alternatively, the material can be suspended or emulsified in a non-solvent to form a suspension or emulsion. Other ingredients (as discussed above) or components such as anti-microbial agents, stabilising agents, dyes and agents assisting with the drying process may optionally be added at this stage.

15

The solution then is atomised to form a fine mist of droplets. The droplets immediately enter a drying chamber where they contact a drying gas. The solvent is evaporated from the droplets into the drying gas to solidify the droplets, thereby forming particles. The particles are then separated from the drying gas and collected.

20

Products

25 Any product which can benefit from the composition may be used in the present invention. These include but are not limited to fruit conserves and dairy foods and dairy food-derived products, cosmetic and pharmaceutical products.

30 By way of example, the composition of the present invention can be used as an ingredient to soft drinks, a fruit juice or a beverage comprising whey protein, health teas, cocoa drinks, milk drinks and lactic acid bacteria drinks, yoghurt and drinking yoghurt, cheese,

ice cream, water ices and desserts, confectionery, biscuits cakes and cake mixes, snack foods, balanced foods and drinks, fruit fillings, care glaze, chocolate bakery filling, cheese cake flavoured filling, fruit flavoured cake filling, cake and doughnut icing, instant bakery filling creams, filling for cookies, ready-to-use bakery filling, reduced
 5 calorie filling, adult nutritional beverage, acidified soy/juice beverage, aseptic/retorted chocolate drink, bar mixes, beverage powders, calcium fortified soy/plain and chocolate milk, calcium fortified coffee beverage.

The composition can further be used as an ingredient in food products such as American
 10 cheese sauce, anti-caking agent for grated & shredded cheese, chip dip, cream cheese, dry blended whip topping fat free sour cream, freeze/thaw dairy whipping cream, freeze/thaw stable whipped tipping, low fat & lite natural cheddar cheese, low fat Swiss-style yoghurt, aerated frozen desserts, hard pack ice cream, label friendly, improved economics & indulgence of hard pack ice cream, low fat ice cream: soft serve, barbecue sauce, cheese
 15 dip sauce, cottage cheese dressing, dry mix Alfredo sauce, mix cheese sauce, dry mix tomato sauce and others.

For certain aspects, preferably the present invention may be used in connection with yoghurt production, such as fermented yoghurt drink, yoghurt, drinking yoghurt, cheese,
 20 fermented cream, milk based deserts and others.

The present invention also provides a method of preparing a food or a food ingredient, the method comprising admixing the composition according to the present invention with another food ingredient.

25

Advantageously, the present invention relates to products that have been contacted with the composition of the present invention (and optionally with other components/ingredients), wherein the composition is used in an amount to be capable of improving the aroma, flavour, mildness, consistency, texture, body, mouth feel, firmness,
 30 viscosity, gel fracture, wheying off, structure and/or organoleptic properties, nutrition and/or health benefits of the product.

As used herein the term "contacted" refers to the indirect or direct application of the composition of the present invention to the product. Examples of the application methods which may be used, include, but are not limited to, treating the product in a material comprising the composition; direct application by mixing the composition with the product, spraying the composition onto the product surface or dipping the product into a preparation of the composition.

Where the product of the invention is a foodstuff, the composition of the present invention is preferably admixed with the product. Alternatively, the composition may be included in the emulsion or raw ingredients of a foodstuff. In a further alternative, the composition may be applied as a seasoning, glaze, colorant mixture, and the like.

For some applications, it is important that the composition is made available on or to the surface of a product to be affected/treated. This allows the composition to impart one or more of the following favourable characteristics: improving the aroma, flavour, mildness, consistency, texture, body, mouth feel, viscosity, structure, serenity and/or organoleptic properties, nutrition and/or health benefits.

The compositions of the present invention may be applied to intersperse, coat and/or impregnate a product with a controlled amount of a viable micro-organism and/or enzyme produced by said micro-organism and/or EPS produced by said enzyme. Mixtures of viable micro-organisms and enzyme produced by said micro-organism and EPS produced by said enzyme may also be used and may be applied separately, simultaneously or sequentially.

Food

The composition of the present invention may be used as – or in the preparation of – a food. Here, the term "food" is used in a broad sense – and covers food for humans as

well as food for animals (i.e. a feed). In a preferred aspect, the food is for human consumption.

5 The food may be in the form of a solution or as a solid – depending on the use and/or the mode of application and/or the mode of administration.

When used as – or in the preparation of - a food – such as functional food - the composition of the present invention may be used in conjunction with one or more of: a nutritionally acceptable carrier, a nutritionally acceptable diluent, a nutritionally acceptable excipient, a nutritionally acceptable adjuvant, a nutritionally active ingredient.

Preferably, the composition is used to ferment milk or sucrose fortified milk or lactic media with sucrose and/or maltose where the resulting media containing all components of the composition - i.e. said lactobacilli, and/or said enzyme and/or said EPS - can be added as an ingredient to yoghurt milk in suitable concentrations – such as for example in concentrations of from about 0.1% to about 2% - before or alternatively after the fermentation of the yoghurt. The addition of the composition leads to an increase in viscosity and provides a firm mouth feel yoghurt, reduction in serenity (serum separation) and with an improvement in organoleptic properties of the end product.

20

Food ingredient

The composition of the present invention may be used as a food ingredient.

25 As used herein the term “food ingredient” includes a formulation which is or can be added to functional foods or foodstuffs as a nutritional supplement and/or fiber supplement. The term food ingredient as used here also refers to formulations which can be used at low levels in a wide variety of products that require gelling, texturising, stabilizing, suspending, film-forming and structuring, retention of juiciness and improved mouthfeel, without adding
30 viscosity.

The food ingredient may be in the form of a solution or as a solid – depending on the use and/or the mode of application and/or the mode of administration.

Food Supplements

The composition of the present invention may be – or may be added to - food supplements.

Functional foods

The composition of the present invention may be – or may be added to - functional foods.

As used herein, the term “functional food” means food which is capable of providing not only a nutritional effect and/or a taste satisfaction, but is also capable of delivering a further beneficial effect to consumer.

Accordingly, functional foods are ordinary foods that have components or ingredients (such as those described herein) incorporated into them that impart to the food a specific functional – e.g. medical or physiological benefit - other than a purely nutritional effect.

Although there is no legal definition of a functional food, most of the parties with an interest in this area agree that they are foods marketed as having specific health effects.

Some functional foods are nutraceuticals. Here, the term “nutraceutical” means a food which is capable of providing not only a nutritional effect and/or a taste satisfaction, but is also capable of delivering a therapeutic (or other beneficial) effect to the consumer. Nutraceuticals cross the traditional dividing lines between foods and medicine.

Surveys have suggested that consumers place the most emphasis on functional food claims relating to heart disease. Preventing cancer is another aspect of nutrition which interests consumers a great deal, but interestingly this is the area that consumers feel they

can exert least control over. In fact, according to the World Health Organization, at least 35% of cancer cases are diet-related. Furthermore claims relating to osteoporosis, gut health and obesity effects are also key factors that are likely to incite functional food purchase and drive market development.

5

Fibre Supplement

In another aspect, the composition of the present invention may be used as – or in the preparation of – a fibre supplement.

10

Initially, the success of a food product virtually hinged on the word "fibre" or, subsequently, "bran". Despite conflicting studies on fibre's specific health attributes, the overall consensus among experts and consumers is that most people need more fibre in their diet. Fibre has further proven to be useful for its functional properties, such as water absorption and bulk-building in reduced-fat foods.

15

Fibre has gone by a number of names over the years, including "roughage," "bulk," "bran", "fibre", "plant residue", "plantix" and "unavailable carbohydrates". Even today, devising a concise, yet complete, definition for dietary fibre is no simple task because dietary fibre is a complex matrix of various components defined differently among various scientific disciplines.

20

Here, the term fibre is used in the context of food and as such it is referred to as non-digestible material. Specifically, fibre consists of cellulose, hemicellulose, pectins, gums, mucilages and lignin.

25

Not every fibre source contains all of these components. Actually, it is the sheer number of potential combinations that results in the wide variety of different physiological and functional effects observed in different fibre ingredients. By the same token, not every fibre source is 100% dietary fibre.

30

"Total dietary fibre (TDF) is defined as non-digestible carbohydrates," says Diane Lardiere, national sales and marketing manager, Canadian Harvest, Cambridge, MN. "Wheat bran is only 40% TDF, but is considered a fiber ingredient".

5 Thus, the composition of the present invention may be added to - fiber supplements.

It is within the scope of the present invention that the composition is used as a supplement to a diet in combination with different conventional fiber sources as detailed above. The recommended dose of fiber intake for adults is between 20 and 35 grams per
10 day or 10-13 grams per every 1000 calories consumed and for children, generally, the intake is based on their age or weight 0.5 grams of fiber per kilogram of body weight (or 0.23 grams per pound of body weight) with an upper limit of 35 grams of fiber per day.

It is also within the scope of the invention to provide a means ensuring that the
15 recommended daily fiber intake (20-35 grams per day or 10-13 grams per every 1000 calories consumed) is achievable. Such tablets, pills, capsules, ovules, solutions or suspensions, can be formulated to substitute for meals and snacks, especially during the beginning of a weight-loss program.

20 Importantly from a health point of view, when fiber tablets, pills, capsules, ovules, solutions or suspensions are taken with meals, it helps reduce the consequent rise in blood glucose after eating and enhances satiety.

It is also within the scope of this application that the composition of the present invention
25 be incorporated in a fiber beverage. Research has indicated that soluble fiber, may help support digestive health and that a diet high in soluble fiber (at least 25 grams per day) may help maintain normal cholesterol levels.

Probiotic

For some applications, it is believed that the viable lactic acid micro-organisms in the composition of the present invention can exert a probiotic culture effect. Here, a prebiotic is:

"a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or the activity of one or a limited number of bacteria in the colon." (Am Clin Nutr, 2001; 73:406S-409S.).

According to the latest consensus report (van Loo *et al.*, 1999, *Br. J. Nutr.*, 81: 121-132) the definition for prebiotic is an increase in the number and/or activity of mainly bifidobacteria or lactic acid bacteria in the gastrointestinal tract. Here, it is known that: bifidobacteria may help fight a wide range of harmful and food-poisoning bacteria, including the potentially fatal *E coli* 0157 and *E coli* H88; bifidobacteria can prevent young children suffering from diarrhoea; Lactobacillus GG can be helpful in treating antibiotic-associated diarrhoea; and Lactobacillus GG has also been shown effective at treating some cases of travellers' diarrhoea and rotavirus infection, the most common cause of diarrhoea in children world wide.

It is also within the scope of the present invention to add to the composition of the present invention further probiotic cultures.

The term "probiotic culture" as used herein defines live micro-organisms which beneficially affect the host organism by improving its intestinal microbial balance. The term "probiotic" as used herein also encompasses live micro-organisms that can stimulate the beneficial branches of the immune system and at the same time decrease the inflammatory reactions in the gut. In this regard, the use of the composition of the present invention, containing said probiotic ingredient for anti-cancer therapy and prevention of allergies and ulcerative colitis is also contemplated.

Whilst there are no lower or upper limits for probiotic intake, it has been suggested that at least 10,000 viable cells per ml of product will give the micro-organism a competitive chance within the gut flora.

5

In addition to the prebiotic effect of the composition of the present invention, it is also within the scope of the present invention to provide prebiotics as other compounds which can be included in a combination along with the composition. The prebiotic component of the combination comprising the composition of the present invention are characterised with slow fermentation in the large bowel. Such prebiotics can exert a positive effect on the gut flora, specifically in the left side of the colon, an area of the gut which is especially prone to disorders in particular bowel cancer and ulcerative colitis.

15

The present invention also contemplates using both pre- and probiotics as ingredients in a combination along with the composition of the present invention which when combined, become synbiotics. The purpose of this is to combine the effects of new beneficial bacteria and the stimulation of the body-own beneficial bacteria. There is a high potential in the development and the consumption of such mixtures, since some of these may well show powerful synergistic nutritional effects.

20

Thus the composition of the present invention may be specifically designed to contain different components which can provide a symbiotics effect to the consumer.

25

Pharmaceutical

30

The composition of the present invention may be used as – or in the preparation of – a pharmaceutical. Here, the term “pharmaceutical” is used in a broad sense – and covers pharmaceuticals for humans as well as pharmaceuticals for animals (i.e. veterinary

applications). In a preferred aspect, the pharmaceutical is for human use and/or for animal husbandry.

5 The pharmaceutical can be for therapeutic purposes – which may be curative or palliative or preventative in nature. The pharmaceutical may even be for diagnostic purposes.

When used as – or in the preparation of - a pharmaceutical, the composition of the present invention may be used in conjunction with one or more of: a pharmaceutically acceptable carrier, a pharmaceutically acceptable diluent, a pharmaceutically acceptable
10 excipient, a pharmaceutically acceptable adjuvant, a pharmaceutically active ingredient.

The pharmaceutical may be in the form of a solution or as a solid – depending on the use and/or the mode of application and/or the mode of administration.

15 Pharmaceutical ingredient

The composition of the present invention may be used as pharmaceutical ingredients. Here, the composition may be the sole active component or it may be at least one of a number (i.e. 2 or more) active components.

20

The pharmaceutical ingredient may be in the form of a solution or as a solid – depending on the use and/or the mode of application and/or the mode of administration.

Forms

25

The composition of the present invention may be used in any suitable form – whether when alone or when present in a combination with other components or ingredients. Likewise, combinations comprising the composition of the present invention and other components and/or ingredients (i.e. ingredients – such as food ingredients, functional
30 food ingredients or pharmaceutical ingredients) may be used in any suitable form.

The composition the present invention may be used in the form of solid or liquid preparations or alternatives thereof. Examples of solid preparations include, but are not limited to tablets, capsules, dusts, granules and powders which may be wetttable, spray-dried, freeze-dried or lyophilised. Examples of liquid preparations include, but are not limited to, aqueous, organic or aqueous-organic solutions, suspensions and emulsions.

Suitable examples of forms include one or more of: tablets, pills, capsules, ovules, solutions or suspensions, which may contain flavouring or colouring agents, for immediate-, delayed-, modified-, sustained-, pulsed- or controlled-release applications.

10

By way of example, if the composition of the present invention is used in a tablet form – such for use as a functional ingredient – the tablets may also contain one or more of: excipients such as microcrystalline cellulose, lactose, sodium citrate, calcium carbonate, dibasic calcium phosphate and glycine; disintegrants such as starch (preferably corn, potato or tapioca starch), sodium starch glycollate, croscarmellose sodium and certain complex silicates; granulation binders such as polyvinylpyrrolidone, hydroxypropylmethylcellulose (HPMC), hydroxypropylcellulose (HPC), sucrose, gelatin and acacia; lubricating agents such as magnesium stearate, stearic acid, glyceryl behenate and talc may be included.

20

Examples of nutritionally acceptable carriers for use in preparing the forms include, for example, water, salt solutions, alcohol, silicone, waxes, petroleum jelly, vegetable oils, polyethylene glycols, propylene glycol, liposomes, sugars, gelatin, lactose, amylose, magnesium stearate, talc, surfactants, silicic acid, viscous paraffin, perfume oil, fatty acid monoglycerides and diglycerides, petroethral fatty acid esters, hydroxymethyl-cellulose, polyvinylpyrrolidone, and the like.

25

Preferred excipients for the forms include lactose, starch, a cellulose, milk sugar or high molecular weight polyethylene glycols.

30

For aqueous suspensions and/or elixirs, the composition of the present invention may be combined with various sweetening or flavouring agents, colouring matter or dyes, with emulsifying and/or suspending agents and with diluents such as water, propylene glycol and glycerin, and combinations thereof.

5

The forms may also include gelatin capsules; fiber capsules, fiber tablets etc.; or even fiber beverages.

EXAMPLES

10

The present invention will now be described by way of examples, and with reference to the accompanying figures:

Figures

15

Figure 1. Evaluation of best strain for exopolysaccharide (EPS) production.

Figure 2. Evaluation of cell count of EPS producing strains.

Figure 3. Evaluation of best temperature for EPS production using *Leuconostoc mesenteroides* 808 strain.

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Figure 4. Evaluation of EPS production and viscosity increase using *Leuconostoc mesenteroides* 808 strain.

Figure 5A. Evaluation of EPS production at different sucrose concentrations using *Leuconostoc mesenteroides* 808 strain.

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Figure 5B. Evaluation of viscosity increase at different sucrose concentrations using *Leuconostoc mesenteroides* 808 strain.

Figure 6. EPS production by *Leuconostoc mesenteroides* strains in medium containing different amounts of maltose.

Figure 7. Changes in viscosity produced by *Leuconostoc mesenteroides* 808 strain in a growth medium containing different amounts of maltose.

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Figure 8. Spray drying of *Leuconostoc mesenteroides* 808 strain containing EPS.

Methods

Screening:

- 5 In order to establish which lactic acid bacterial strains are capable of producing EPS for the purposes of the present invention, a number of different strains were screened. The screening method involved the following steps:

10 Micro-organisms of each strain were activated/inoculated in 10ml Lactic media or 9% skim milk-media (containing 0-2% sucrose) and incubated at 25-42°C for 8-20h to form a pre-culture.

15 The pre-culture was subsequently transferred into micro-titre plates. Each well from the micro-titre plates contained 0.2-2 ml Lactic media or 9% Skim milk-media. Each well, which already contained the chosen growth medium, was then inoculated with 1-5% pre-culture and incubated at 25-42°C for 8-20h.

20 Culture from each cavity was then transferred to the surface of a solid lactic media with the aid of a 96-replicator and incubated at 25-42°C for a further 8-20h.

After this incubation period, colonies were examined by eye or in some cases with the aid of a light microscope at magnification setting 10X to identify colonies which exhibit a slimy bubble (EPS). Colonies which contained a slimy bubble were identified as positive and subjected to further analysis.

25

Fermentation:

30 An activation overnight culture is prepared in Lactic or a milk-based media (as set forth above). 1% of this overnight culture is transferred into a media containing at least 2% sucrose and is incubated under fermentation conditions (25-42°C, 8-20h, pH 5,8-7). The fermentation chamber is then inoculated with 1-5% of these pre-cultures.

Lactic growth media (lactic 100b) typically contains: 2% pepton (Merck, Germany), 0.5% yeast extract, 0.25% gelatine, 0.4% NaCl, 0.25% Sodium acetate, 0.05% L-ascorbic acid, 0.05% Tween 80, at least 2% sucrose.

5

EPS-measurement

After separation from contaminants such as proteins the amount of EPS is measured gravimetrically by precipitation with a double volume of chilled (4°C) 96% Ethanol. The precipitate can optionally be incubated at 4°C for several hours to improve the precipitation step after which the precipitated EPS is sedimented by centrifugation and air dried or preferably freeze dried.

10

In more detail:

3ml of the culture from the fermentation chamber culture is added to 6ml 4°C cold 96% Ethanol.

The resulting mixture is then mixed with the aid of a vortex and is then stored overnight at 4°C.

15

After the overnight incubation at 4°C, the precipitate is centrifuged for 15 min at 2500 rpm.

The supernatant is aspirated and the pellet dried for 4-6h at 80°C.

20

Viscosity measurements.

The viscosity of the lactic growth medium supplemented with varying amounts of maltose following fermentation by *Leuconostoc mesenteroides* was measured using the DV II Viscometer (UT 401) following the Manufacturer's instructions.

25

Example 1

A number of different strains were screened in order to find a lactic acid bacterial strain capable of producing EPS. An overnight pre-culture was used to inoculate a fermentation chamber containing 200 ml of lactic growth medium (lactic 100b). The culture was incubated for 72 hours at 30°C without stirring. The ability of each strain to produce EPS was tested at 24 and 72 hours. The results on Figure 1 show that *Leuconostoc mesenteroides* 808-lactic strain at 24 hours produced approximately 28 g/l EPS and at 72 hours produced approximately 43 g/l EPS (see Figure 1).

Example 2

In this example the cell number of EPS producing cells was evaluated. Thus, an overnight pre-culture of each lactic acid bacterial strain was used to inoculate a fermentation chamber containing 200 ml of lactic growth medium (lactic 100b). Each culture was then incubated for 72 hours at 30°C without stirring. The results show that the lactic acid micro-organism *Leuconostoc mesenteroides* 808 strain is capable of maintaining cell numbers at 48 and 72 hour of fermentation higher than any of the other tested strains (see Figure 2).

Example 3

The temperature at which *Leuconostoc mesenteroides* 808 strain produced optimum levels of EPS was tested. An overnight pre-culture of *Leuconostoc mesenteroides* 808 was used to inoculate four different fermentation chambers containing 200 ml of lactic growth medium (lactic 100b). After the inoculation, each fermentation chamber was incubated at 22°C, 25°C, 30°C and 35°C respectively without stirring. The pH at the start of the incubation was measured at a value of pH 7.4 and at the end of the fermentation period the pH was measured to be at a value of pH 4.1. The results presented in Figure 3

show that *Leuconostoc mesenteroides* 808 strain produced maximum levels of EPS at 25°C.

Example 4

5

The production of EPS and the increase in viscosity was evaluated using *Leuconostoc mesenteroides* 808 strain. An overnight pre-culture of *Leuconostoc mesenteroides* 808 strain was used to inoculate a fermentation chamber containing 200 ml of lactic growth medium (lactic 100b). The culture was then incubated for up to 36 hours at 25°C without stirring. The pH at the start of the incubation was measured at a value of pH 7.4 and at the end of the fermentation period the pH was measured to be at a value of pH 4.1. The results of this experiment are shown in Figure 4.

Example 5

15

EPS production and viscosity increase as a function of a varied sucrose concentration using *Leuconostoc mesenteroides* 808 strain were tested. An overnight pre-culture of *Leuconostoc mesenteroides* 808 strain was used to inoculate five different fermentation chambers containing 200 ml of lactic growth medium (lactic 100b) supplemented with 2%, 4%, 6%, 8% and 10% sucrose concentration respectively. The five different cultures were incubated for up to 72 hours without stirring. The pH at the start of the incubation in each chamber was measured at a value of pH 7.4 and at the end of the fermentation period the pH was measured to be at a value of pH 4.1. The results of this experiment show an increase in the EPS production (see Figure 5A), and an increase in viscosity (see Figure 5B), as functions of a varied sucrose concentration.

25

Example 6

Certain enzymes responsible for producing EPS can use maltose as an acceptor molecule which is in turn capable of controlling the chain length of the EPS sugar polymer formation and consequently the level of viscosity. Experiments were performed in order

30

to ascertain the affect of maltose on EPS-chain length and viscosity using different *Leuconostoc mesenteroides* strains. One per cent of an overnight pre-culture of different *Leuconostoc mesenteroides* strains grown in lactic growth medium was used to inoculate different fermentation chambers containing 200 ml of lactic growth medium supplemented with:

10% sucrose,

5% sucrose and 5% maltose (50/50 ration of sucrose/maltose)

7.5% sucrose and 2.5% maltose (75/25 ration of maltose/sucrose)

10

The cultures were incubated for up to 72h without stirring and measurements for EPS production were taken at time points 24, 48 and 72 hours post-inoculation. The data presented on Figure 6 shows that a significant amount of EPS is produced by the *Leuconostoc mesenteroides* 808 strain. The data also shows that the amount of EPS produced by *Leuconostoc mesenteroides* 808 can be modulated by the addition of varying amounts of maltose. Thus at 72 hours *Leuconostoc mesenteroides* 808 strain can produce approximately 36 g/L of EPS in a growth medium supplemented with 10% sucrose (Figure 6). The graph of Figure 6 also shows that the amount of EPS produced by *Leuconostoc mesenteroides* 808 was substantially reduced with the addition of varying amounts of maltose to the growth medium (Figure 6). The reduction in EPS production is likely due to the fact that maltose can induce the production of shorter polysaccharide chains. The reduction in the length of the polysaccharide chains can lead to an increase in fluidity i.e. reduction in viscosity. The results on Figure 7 show that the viscosity of a growth medium containing 10% sucrose is greater than 4000 mPa which is dramatically reduced to 14 mPa in the medium containing a ratio of 75/25 sucrose/maltose and further reduced to 10 mPa at a ration of 50/50 Sucrose/Maltose. The results shown in Figure 6 and Figure 7 show that shorter, less viscous chains are formed with maltose as acceptor molecule which leads to a drop in EPS production and a drop in viscosity.

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Example 7

The viability of *Leuconostoc mesenteroides* 808 strain in the presence of EPS was tested following spray drying. An overnight pre-culture of *Leuconostoc mesenteroides* 808 strain was used to inoculate a fermentation chamber containing 20 litres of lactic medium supplemented with 1% sucrose. The culture was then incubated for 72 hours without stirring. Figure 8 shows the viability of *Leuconostoc mesenteroides* 808 strain before and after spray drying in the presence of 5% Glucidex®, 10% Glucidex® and 10% skimmed milk. Glucidex® is a blend of nutritive saccharides, produced by controlled enzymatic hydrolysis which are routinely used in the food industry, particularly in milk fermentation products. Glucidex® can be used as a sweetening agent but preferably as a spray-drying saccharide rich syrup to improve the technical performance of the composition of the present invention, taste and cost effectiveness.

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All publications mentioned in the above specification are herein incorporated by reference. Various modifications and variations of the described methods of the invention will be apparent to those skilled in the art without departing from the scope and spirit of the invention. Although the invention has been described in connection with specific preferred embodiments, various modifications of the described modes for carrying out the invention which are obvious to those skilled in microbiology or related fields are intended to be within the scope of the following claims.

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CLAIMS

1. A composition for consumption, said composition comprising a viable lactic acid micro-organism, an enzyme synthesised by said micro-organism and an exopolysaccharide (EPS) product of said enzyme.
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2. A composition according to claim 1 wherein the EPS product is formed *in situ* by cultivating the lactic acid micro-organism with a suitable enzyme substrate.
- 10 3. A composition according to claim 1 or claim 2 wherein said enzyme is either a glycosyl transferase enzyme or a fructosyl transferase enzyme capable of polymerising sucrose.
4. A composition according to claim 1 or claim 2 or claim 3 wherein the lactic acid micro-organism belongs to the genus *Lactibacillus*.
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5. A composition according to claim 1 or claim 2 or claim 3 wherein the lactic acid bacterium belongs to the genus *Leuconostoc*.
- 20 6. A composition according to claim 5 wherein said viable lactic acid bacterium is *Leuconostoc mesenteroides*.
7. A composition according to claim 6 wherein said EPS is obtained following fermentation by *Leuconostoc mesenteroides* which expresses glycosyl transferase or fructosyl transferase.
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8. A composition according to claim 7 wherein the polysaccharide or the oligosaccharide component of the EPS comprises fructan or glucan.
- 30 9. A composition according to claim 8 wherein the oligosaccharide is fructo-oligosaccharide or gluco-oligosaccharide.

10. A composition according to any preceding claim wherein said EPS improves the texture, body, mouth feel, viscosity, structure and/or organoleptic properties of food product containing said EPS as an ingredient.
- 5
11. A composition according to any preceding claim wherein the composition is used to ferment milk and produce a yoghurt like ingredient containing structure forming EPS and/or nutritional oligosaccharide.
- 10
12. A composition according to any preceding claim wherein said composition is in a concentrated form.
13. A composition according to any preceding claim wherein said composition is freeze dried, spray dried and/or resuspended.
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14. A method of preparing a product for consumption, the method comprising admixing a composition with another component so as to form said product for consumption; wherein said composition is a composition according to any one of claims 1 to 13.
- 20
15. A product for consumption obtained by the method of claim 14.
16. A method for preparing a food product, the method comprising admixing a composition with another component so as to form said food product; wherein said composition is a composition according to any one of claims 1 to 13.
- 25
17. A food product obtained by the method of claim 16.
18. A product according to claim 15 or claim 17 wherein the composition is added to a dairy product, preferably to yoghurt milk.

19. A product according to claim 18 wherein the composition is added to yoghurt milk before and/or after the fermentation of said milk.

5 20. The product according to claim 17 or claim 19 wherein the product is a functional food.

21. A method of making a pharmaceutical product, the method comprising admixing a composition with another component to produce said pharmaceutical product wherein said composition is a composition according to any one of claims 1 to 13.

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22. A pharmaceutical product produced by the method of claim 21.

23. A container comprising a composition, wherein said composition is a composition according to any one of claims 1 to 13.

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24. A container comprising a composition, wherein said composition is a composition according to any one of claims 1 to 13, and wherein said container has thereon a label indicating use and/or approval for use to improve the microbial balance of the gastrointestinal tract after consumption of said product.

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25. A process for producing an EPS or an enzyme as defined in any preceding claim comprising:

growing *Leuconostoc mesenteroides* which produces an enzyme capable of synthesising an EPS in a commercially acceptable medium, and optionally,
25 isolating the EPS and/or the enzyme.

26. A process for preparing an EPS as defined in any preceding claim comprising:
growing *Leuconostoc mesenteroides* which produces an enzyme capable of synthesising an EPS in a commercially acceptable medium supplemented with
30 sucrose and maltose as the only carbon source, and optionally,
isolating the EPS.

27. Use of an EPS produced by the process of claim 26 for modulating the viscosity of products for consumption.

5 28. A process for producing a composition comprising growing *in situ* said lactic acid micro-organism in a commercially acceptable medium whereby said lactic acid micro-organism produces an enzyme capable of synthesising an EPS until the numbers of said lactic acid micro-organism in the order of is in the order of 10^3 to 10^{11} per ml, preferably 10^5 to 10^{10} per ml and more preferably 10^9 to 10^{10} per ml.

- 10 29. Use of a composition according to any one of claims 1 to 13 in the manufacture of a food product, wherein said composition improves the texture, body, mouth feel, viscosity, structure and/or organoleptic properties of the food product.

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30. An assay for screening a composition for use substantially as described herein, said assay comprising adding a candidate composition to a food product and determining the extent of improvement in the texture, body, mouth-feel, viscosity, structure and/or organoleptic properties of food product; wherein said composition comprises a viable lactic acid bacterium, an enzyme derivable from said lactic acid bacterium and an EPS produced by said enzyme.

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31. Use of a composition as a functional food ingredient substantially as described herein.

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32. Use of a composition as a prebiotic and/or probiotic food ingredient substantially as described herein.

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33. A composition, a food product, a method, a process, a use, or an assay substantially as described herein.

ABSTRACT

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COMPOSITION

The present invention relates to a composition and a method of preparing or treating food products so as to improve their aroma, flavour, mildness, consistency, texture, body, mouth feel, firmness, viscosity, gel fracture, wheying off, structure and/or organoleptic properties, nutrition and/or health benefits. In particular, the present invention provides a composition comprising a live micro-organism, an enzyme produced by said micro-organism and an exopolysaccharide (EPS) produced by the activity of said enzyme.

Figure 1

Evaluation of best strain for exopolysaccharide (EPS) production.

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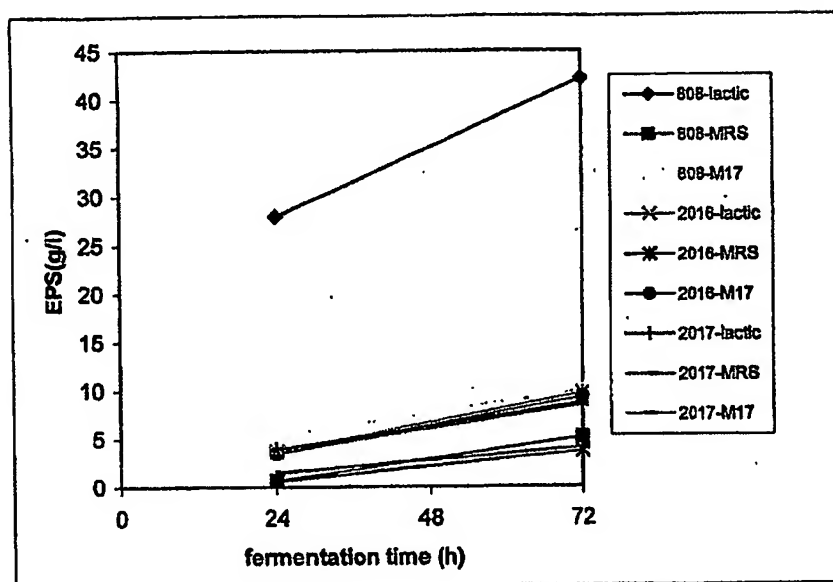


Figure 2.

Evaluation of cell count of EPS producing strains

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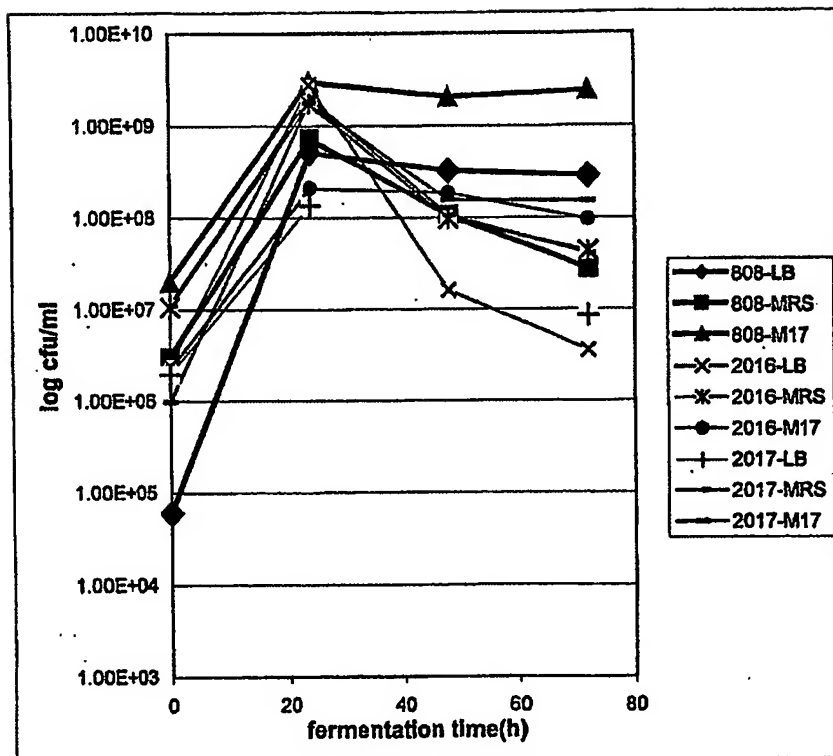


Figure 3

Evaluation of best temperature for EPS production using *Leuconostoc mesenteroides* 808

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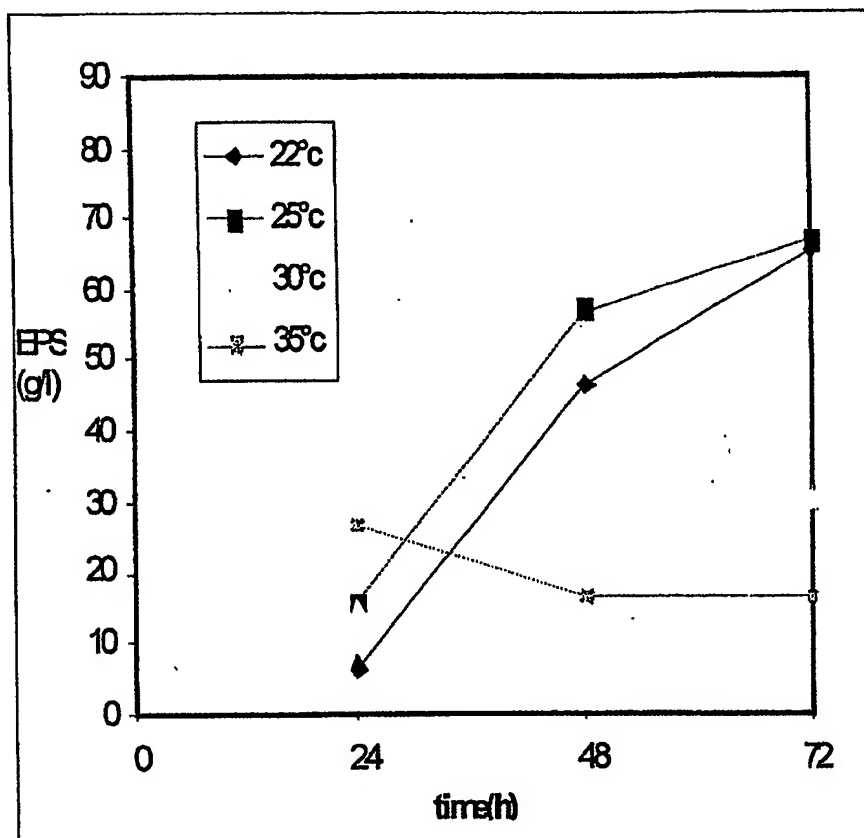


Figure 4

Evaluation of EPS production and viscosity increase using *Leuconostoc mesenteroides*

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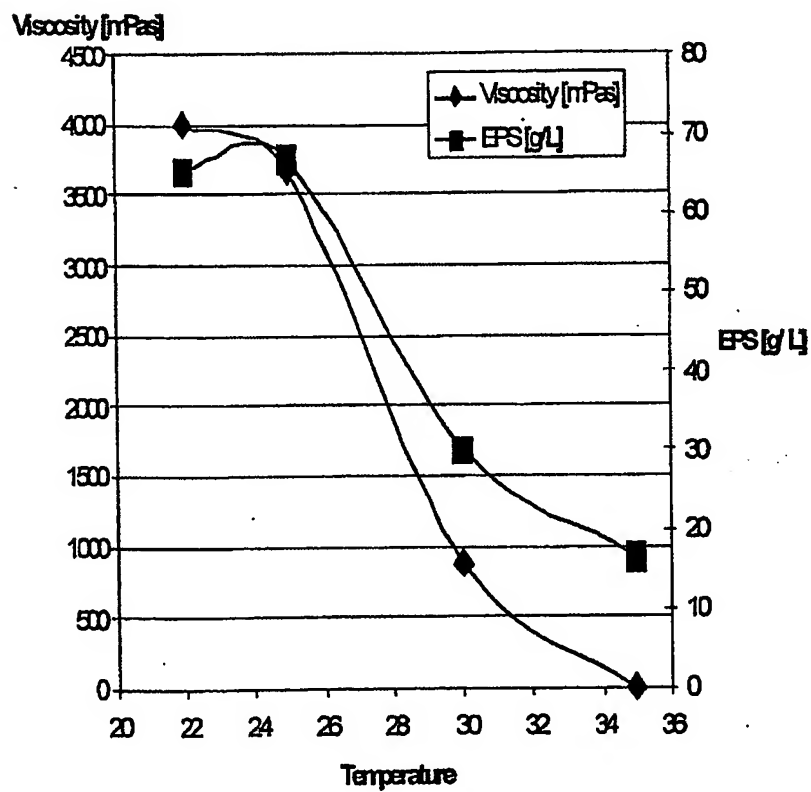


Figure 5A

Evaluation of EPS production as a function of a varied sucrose concentration using *Leuconostoc mesenteroides* 808.

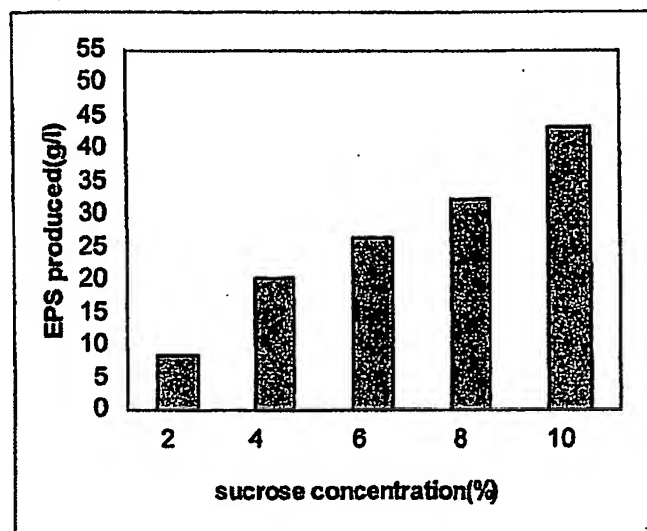


Figure 5B

Evaluation of EPS production and viscosity increase as a function of a varied sucrose concentration using *Leuconostoc mesenteroides* 808

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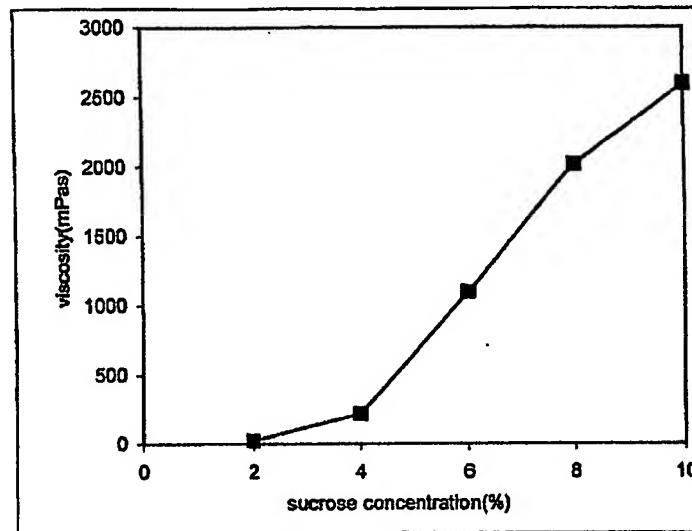
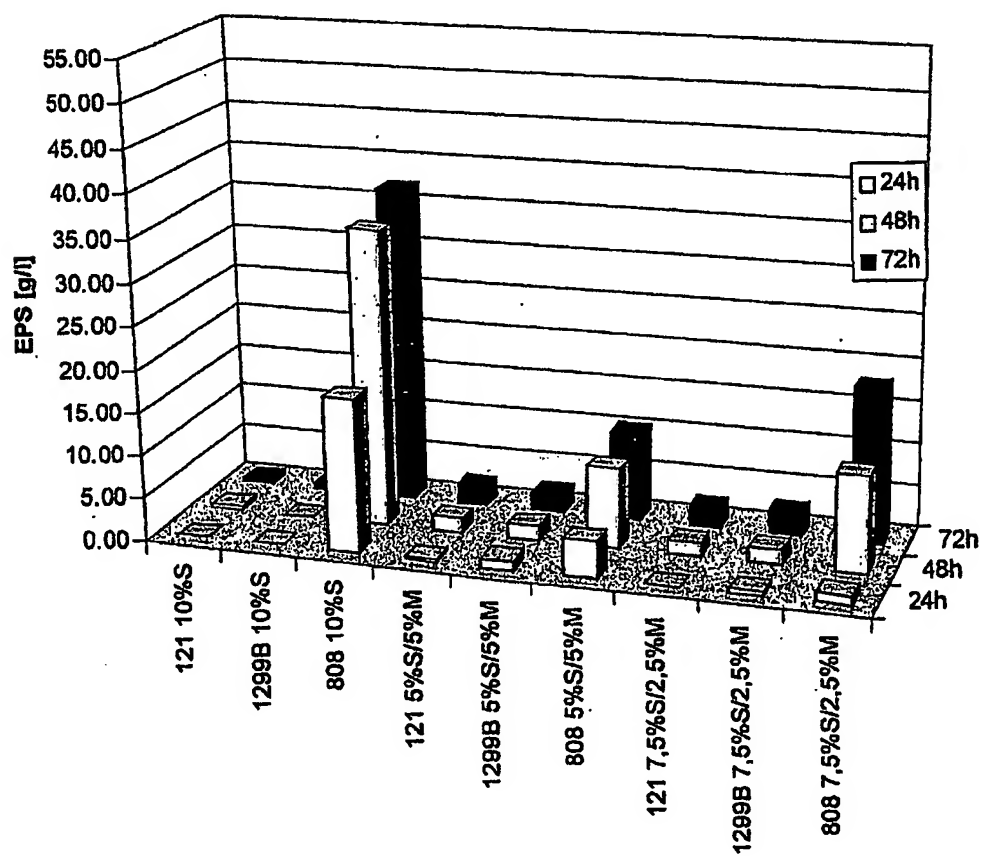


Figure 6

EPS production by *Leuconostoc mesenteroides* 121, 808, 1299B strains in growth medium supplemented with different amounts of sucrose/maltose.

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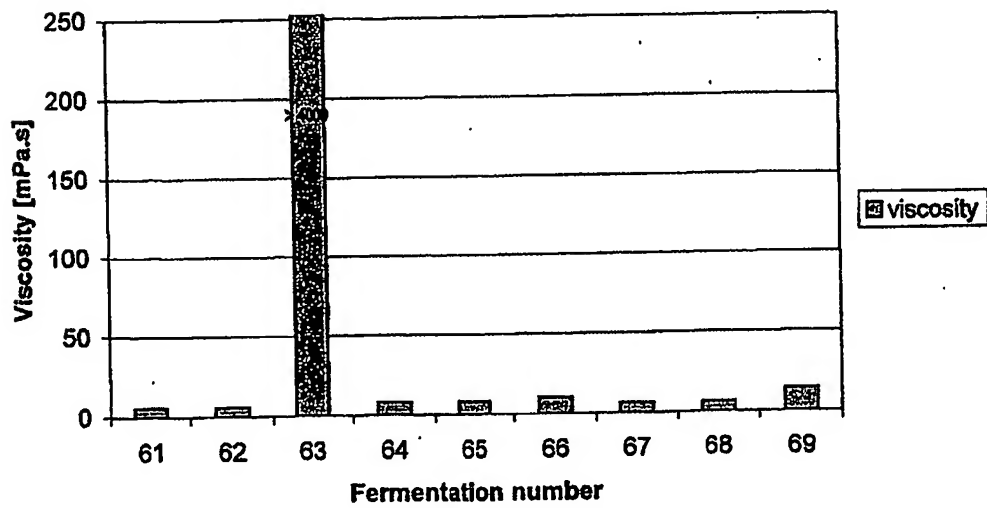


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Figure 7

Changes in viscosity produced by *Leuconostoc mesenteroides* 808 strain in growth medium supplemented with different amounts of sucrose/maltose.

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Figure 8

5 Spray drying of *Leuconostoc mesenteroides* 808 containing EPS ingredient .

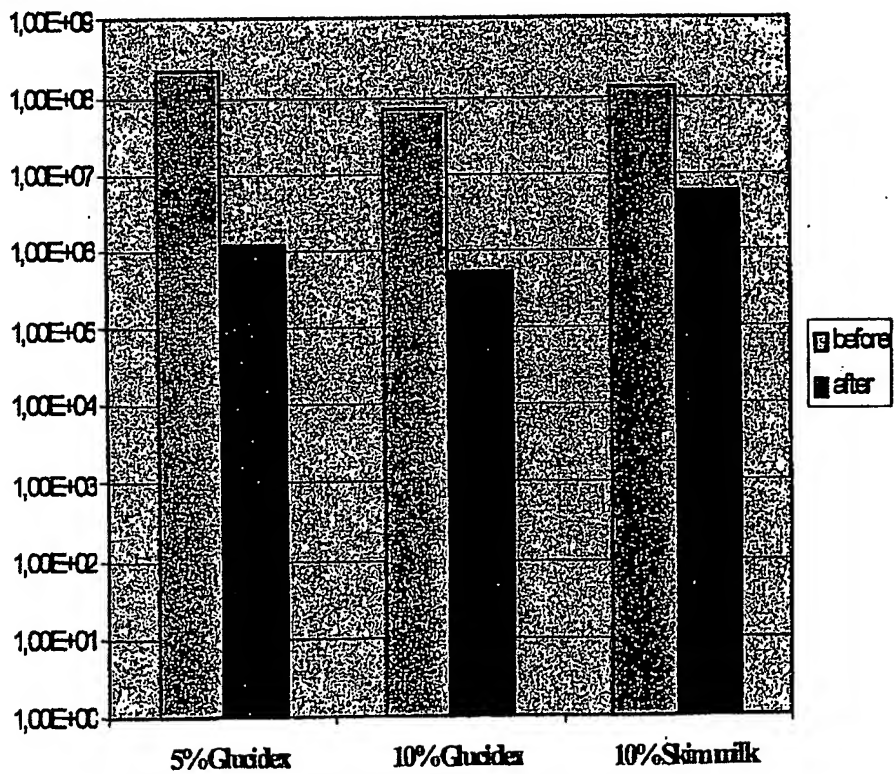
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